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ABSTRACT

Admissions officers devote substantial resources to high school visits and other recruiting events. Economic theory indicates that the best measure of effectiveness is marginal productivity. Subjects in this study were applicants to a large, Catholic, urban university and all students who participated in recruiting programs in fall 2002. Researchers aggregated the records of 70,946 prospective students to provide data for 10,133 high schools. A regression model was used to estimate the marginal effects of four categories of recruiting activities on applications for admissions while controlling for high school characteristics. Each type of activity had positive effects. The regression model was then used to predict the marginal effects of prospective high school visits and to rank them accordingly. Certain characteristics of the high schools were positively related to applications, such as the number of applications received in the previous year. Marketing activities before senior year also had a positive effect on applications. The analysis suggests changes to the visit program that would yield an increase in applications. (Contains 2 tables and 10 references.) (Author/SLD)

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The Marginal Effects of High School Visits: A Step Toward an Empirically Driven Marketing Program

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The Marginal Effects of High School Visits: A Step Toward an Empirically Driven Marketing Program

Abstract

Admissions officers devote substantial resources to high school visits and other recruiting events. Economic theory indicates that the best measure of effectiveness is marginal productivity. The authors used a regression model to estimate the marginal effects of four categories of recruiting activities on applications for admission while controlling for high school characteristics. Each type of activity had positive effects. The regression model was then used to predict the marginal effects of prospective high school visits and to rank them accordingly. The analysis suggests changes to the visit program that would yield an increase in applications.

The Marginal Effects of High School Visits: A Step Toward an Empirically Driven Marketing Program

"A basic theorem is that it is in the best interests of a firm, a consumer, or any other economic unit to require that any decision take into account the magnitude of the marginal yield which it promises" (Baumol, 1977, p. 22).

Since college admissions officers devote substantial time and money to recruiting events such as high school visits, they should allocate such resources effectively. The critical indicator of effectiveness of an activity is its marginal productivity (Baumol, 1977), that is the increase in benefits resulting from a one unit increase in the activity while holding all other inputs constant. To assist admissions officers at the authors' university identify schools that would be productive to visit, this study estimates the marginal effects of school visits on applications for admission, while controlling for effects of other recruiting activities and high school characteristics. A second component of this research is to use the estimates of marginal effects to identify schools that would be most productive to visit. In this investigation, the measure of productivity is the number of additional applications from high school seniors a visit would be expected to generate.

The authors have found no research that measures the *marginal effects* of high school visits and related recruiting activities on applications or enrollment. However, Gamache (1981) found that as the number of pre-enrollment contacts, including high school visits, increased, the proportions of students applying, enrolling, and persisting rose. Other researchers have conducted studies on perceptions of a college after participation in recruiting activities (Kealy & Rokel, 1987) and of respondents' judgments of the effectiveness of recruiting activities (Dalton, 1982; Heckscher, 1985; Maguire, 1981). The results of these studies were mixed. Although such surveys provide some indication of the value of various recruiting activities and information

sources, all those reviewed here are based on perceptions or on subjective assessments. They do not measure the effects of recruiting activities on behavior.

There is very little research on how admissions officers choose schools to visit. Weir (1991) describes a model one college used for ranking high school visits in order of importance. Prospective visits were ordered according to the numbers of college-bound seniors in a high school and counts of those seniors who applied and enrolled at the college. In the ranking formula the components are weighted to emphasize enrollment over applications and applications over number of college-bound seniors. The model makes intuitive sense. However, it does not assign priorities according to any measured effects of school visits.

The admissions office at the authors' university used a model conceptually similar to that which Weir (1991) reported. To test the utility of a visitation program guided by estimates of marginal yields, the authors developed a preliminary regression model of the effects of high school visits on applications for the fall 2001 term (Aguilar & Gillespie, 2001). The results indicated that the entire school visitation program had a relatively small marginal effect on total applications, but that scheduling visits to maximize marginal effects would have increased the yield in the form of applications from visits by 27 percent. Although the admissions office already had made some appointments for visits when we presented our results, they made some cautious modifications to their recruiting program. Encouraged by this, the authors undertook the present research.

Method

Data Source

The subjects in this study were students who applied for admission to a large, Catholic, urban university for fall 2001 and 2002 semesters and all students who participated in recruiting

programs for fall 2002. Prospective students completed information cards in response to each recruiting activity they participate in. The university maintains records of each student's involvement in each marketing program, the date of the event, and the individual's high school. Because the university has collected data in its current form since 1999, information on prospective students for the fall 2002 term includes participation in recruiting events since the beginning of the sophomore year in high school.

The investigators consolidated marketing programs into four categories: responses to direct mail, visits by students to the college campus, high school visits by admissions officers, and what we call "other visits," i.e., attendance at college fairs, days, or nights. The investigators aggregated the records of 70,946 prospective students to provide data for 10,133 high schools.

Regression Model

In the regression model, the unit of analysis is the high school, and the dependent variable is the number of applications for fall 2002 received from each high school. Since this is an exploratory study, the authors tested a variety of variables to determine which were significant and stable. The resulting model incorporated 14 independent variables representing (1) number of students who participated in each of the four categories of recruiting activity before senior year (i.e., from fall 1999 through fall 2001), (2) applications for fall 2001, (3) location of the high school within commuting distance of the university, (4) whether the high school is a Catholic school or not, and (5) interaction terms.

The variables included in the model are of two types: contextual variables and policy variables. Table 1 lists the abbreviated names of the variables and descriptions of each.

Contextual variables. Eight contextual variables contain information about prospective students for fall 2002 and their high schools. This information is known when admissions

officers schedule school visits. In the regression model, the contextual variables control for influences on application activity that exist prior to the university's determining which schools it will visit.

Four variables capture involvement in recruiting events prior to the senior year of the cohort: (1) replies to direct mail (DM9900), (2) campus visits (CV9900), (3) high school visits (HSV9900), and (4) other visits (OTV9900). These variables indicate *the number of response cards that sophomores or juniors from a given high school completed.* The coefficients of these variables reflect the marginal effects of the event *per respondent*. The marginal effect of the activity *per school* is the product of the coefficient of the variable representing the recruiting program times the number of responses to it. (See top panel of Table 1.)

The remaining contextual variables indicate other information about the high school: (5) location within commuting distance (METRO), (6) affiliation with the Catholic church (CATHOLIC), (7) an indicator variable signifying a visit to the high school in the prior year (VISPREV), and (8) the number of applications received from a high school in the previous year (APP01). (See second panel of Table 1.)

Policy variables. Unlike the contextual variables, the policy variables are within the control of admissions officers when they are planning high school and other visits at the start of the senior year of the cohort of prospective students.

When used in a regression model, the coefficients of the policy variables indicate the marginal effect of a high school or other visit. By separating the marginal effect of a high school visit from other determinants of application activity, the coefficients of the policy variables provide estimates of the increment in admissions applications resulting from visits. These effects are independent of any other influences.

In the model, there are six policy variables. Two are main effects: (1) a high school visit (HSVIND) and (2) other visits (OTVIND). Both main effects are dummy coded (0 = no visit; 1 = visit). The remaining four variables are interactions of the main effects with contextual variables: (3) visit to a school within commuting distance (HSVXMET), (4) high school visits times campus visits (HSVXCV), (5) a high school visit in senior year with a high school visit in the previous year (HSVXPREV), and (6) visit to a Catholic high school (HSVCATH). These interaction terms are included to further utilize high school-specific information available in the database when estimating the marginal effect of a high school visit. (See the last panel of Table 1.)

Alpha level of significance tests. An alpha level of .05 was used for all statistical tests in this analysis.

Simulation of Marginal Effects of High School Visits for the Fall 2003 Recruitment Program

The parameter estimates obtained from the regression of fall 2002 applications on the context and policy variables were applied to data on the fall 2003 cohort in order to generate forecasts of the marginal effect of a visit to each of the high schools in the database. The data were for prospective students for fall 2003 in the university's records as of May, 2002. We then compared two visit policies in which the same number of schools would be visited. According to the *base case policy*, the admissions officers would visit the same schools as in the 2001-2002 academic year. In an *alternative policy*, schools would be rank-ordered according to the estimated marginal effects of visits. The most productive schools would be visited. The sums of the estimated marginal effects per high school of the base case policy and the alternative policy were compared.

Results

Below, we discuss tests for multicollinearity and heteroscedasticity, the regression results, and the simulation of visit policies.

Testing for Multicollinearity and Heteroscedasticity

The investigators tested for potential multicollinearity and heteroscedasticity. Multicollinearity might prove severe considering that there are fourteen independent variables including interaction terms. However, the degree of multicollinearity was not deemed severe since the condition index of 5.70 was well below the value of 20 that is considered indicative of severe multicollinearity (Greene, 2000). In addition, none of the variance inflation factors for each of the independent variables was above the rule-of-thumb value of 5.

Since the sample consisted of high schools across the country of varying size, proximity from the university, and application activity, heteroscedasticity could be a problem. Indeed, a Breusch-Pagan test conducted on the regression residuals did indicate the presence of heteroscedasticity (Adj. $\underline{R}^2 = .364$, $\underline{F}_{14,1033} = 416.05$, $\underline{p} < .05$; SEE = 15.56). To correct for this problem, the method chosen was to obtain heteroscedasticity-consistent standard errors and retain the ordinary least squares (OLS) parameter estimates (White, 1980). The authors selected this method over performing a generalized least squares regression since the method chosen does not depend on a correctly specified model of the heteroscedasticity. The robust standard errors enable the computation of valid inferential statistics (i.e., t statistics for the individual coefficients).

Regression Results

All t statistics reported are robust in the presence of heteroscedasticity. The regression had an $\underline{R}^2$ of .84 and was significant ($\underline{F}_{14,10133} = 3890.19$, $\underline{p} < .05$; SEE = 1.57). The individual

coefficients are presented in Table 2. In the following discussion of variables, we report beta coefficients (i.e., coefficients of standardized variables), because they enable direct comparisons of the magnitudes of effects of various recruiting activities.

Contextual variables. Three of the four variables that give responses to recruitment activities prior to the senior year were positively related to application volume and significant. The two most influential recruiting techniques, based on the beta coefficients, are student visits to the campus (CV9900, $\beta = 0.118$, $t(10118) = 8.81$, $p < .005$) and college fairs and college nights (OTV9900, $\beta = 0.085$, $t(10118) = 6.34$, $p < .005$). Responses to high school visits made prior to the senior year also have a positive and significant effect (HSV9900, $\beta = 0.027$, $t(10118) = 2.07$, $p < .025$). The effect of direct mail was not significant.

A Catholic high school is likely to provide more applications than one that is not (CATHOLIC, $\beta = 0.011$, $t(10118) = 2.72$, $p < .005$). Similarly, location within commuting distance increases the volume of applications (METRO, $\beta = 0.023$, $t(10118) = 4.47$, $p < .005$).

Applications from the previous year are the greatest factor influencing applications for the current year (APP01, $\beta = 0.684$, $t(10118) = 38.90$, $p < .005$).

Policy variables. The coefficients of the indicator variables representing main effects of high school visits and other visits were both positive and significant (HSVIND, $\beta = 0.022$, $t(10118) = 3.91$, $p < .005$; and OTVIND, $\beta = 0.054$, $t(10118) = 9.93$, $p < .005$) .

The main effect of visiting a high school during the senior year of the fall 2002 cohort was augmented or diminished by the effects of the four interaction variables present in the model. A visit to a high school that was within commuting distance generated more applications than a visit to one that was not (HSVXMET, $\beta = 0.020$, $t(10118) = 2.89$, $p < .005$). The number of students from a high school who visited the university before senior year had a positive and

significant influence on the effect of a senior year visit to that high school (HSVXCV, β = 0.051, $\underline{t}(10118) = 3.69$, $p < .005$). A visit to a Catholic high school had a greater marginal effect on applications than a visit to one that was not (HSVXCATH, $\beta = 0.013$, $\underline{t}(10118) = 1.66$, $p < .05$).

However, if an admissions officer visited a high school during the previous year, the visit attenuated the marginal effect of the current year's visit (HSVXPREV, $\beta = -0.011$, $\underline{t}(10118) = 1.66$, $p < .025$). As was noted, the beta coefficients of the two main effects, a high school visit during senior year and a high school visit during the previous year, are both positive and significant. Though the interaction of a previous visit and a second consecutive visit to a high school has a negative marginal effect, the net effect of the main effect of the senior year contact and this interaction effect was positive.

The marginal effect of a high school visit, i.e. the main plus interaction effects, depended on the values of the interaction variables for a particular high school. For example, if the university visited a Catholic high school within commuting distance from which 20 students visited the campus in sophomore and junior year, and which was visited in the previous year, it would receive 8 additional applications as a result of the high school visit. The formula for the marginal effect is as follows:

$$\text{MARGINAL EFFECT} = B_9(\text{HSVIND}) + B_{11}(\text{HSVXMET}) + B_{12}(\text{HSVXCV}) + B_{13}(\text{HSVXPREV}) + B_{14}(\text{HSVXCATH}).$$

Substituting the numbers from the example gives:

$$7.87 = .401 \times (1) + .561 \times (1) + .339 \times (20) - .284 \times (1) + .414 \times (1).$$

Simulation of Base Case and Alternative Visit Schedules for Fall 2003

The estimates of the marginal effects of school visits were used to simulate a base policy for fall 2003 and an alternative policy. Under the *base case* policy, all the schools visited for fall 2002 would be visited for Fall 2003. The sum of the marginal effects of high school visits is forecasted to be 316 applications. Under the *alternative policy*, the same number of schools would be visited for fall 2003 as for fall 2002. However, schools would be rank-ordered according to the marginal effects of a visit to the school, and the most productive schools would be visited. The marginal effect of the alternative policy is projected to be 580 applications, or an 85% increase over the base case. This translates to 264 more applications. This number underestimates effects because application volumes have been simulated in the month of May, before the records of all pre-senior-year recruiting contacts have been entered in the university's database. The estimated marginal effect per school visit according to the alternative policy ranges from 1 to 9.

Compared with the base policy, under the alternative visit schedule, the proportion of schools within commuting distance that the admissions office would visit would increase from 45% to 65%, while the share of Catholic schools would increase from the current 34% to 57%.

Discussion

The Effects of School Visits

This study estimated the effects that high school characteristics and university recruiting activities have on applications for admission from a single cohort of prospective freshmen. Certain characteristics of high schools were positively related to applications. The number of applications received in the previous year proved to have the strongest effect on current year applications. This variable may be a proxy for reputation or prestige of the university among

secondary school students, or it may represent informal communication networks. In addition, location within commuting distance of the university and a Catholic affiliation also were positively related to applications. Neither of these results is surprising given that the university is better known within commuting distance than in remote markets and that it has a Catholic identity.

Marketing activities before senior year had a positive effect on applications. Campus visits had the greatest effect, followed by college fairs and nights, and high school visits. The effect of direct mail was not significant. There was little variation in direct mailings across schools, because students in virtually all schools in our database received direct mail. The university has conducted controlled experiments of direct mail that indicate that this marketing tool is effective.

Recruiting activities during the senior year—college nights and fairs and visits to high schools—also had positive effects on applications. However, the effects of secondary school visits are qualified by interactions with contextual variables. Specifically, visits are more effective if they are to schools that are Catholic, in commuting distance of the university, or populated with seniors who visited the university in sophomore or junior year. Visits to high schools are less effective if an admissions officer visited the same school during the preceding year. The latter finding indicates diminishing marginal returns to visits from year to year. It is important to note, a repeat visit does not have a negative effect. It simply has a smaller effect than a non-repeat visit. Furthermore, a repeat visit may be more effective than a new visit to a different school.

The model estimates confirm the finding of Gamache (1981) that pre-enrollment contacts increased application volume. They also support the results of the surveys of perceptions (Kealy

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& Rokel, 1987) or judgments (Dalton, 1982; Heckscher, 1985; Maguire, 1981) that indicated that recruiting activities have beneficial effects. This model however, differs from previous studies in that it measures the *marginal* effects of marketing activities *on behavior*. Furthermore, the estimates of the effects of contextual variables reveal the relative importance of several categories of recruitment strategies. Visits to campus by prospective students, though fewer in number than responses of those who attended visits to secondary schools, have a much greater influence on application activity than high school visits. At the same time, secondary school visits in the senior year enhance the effect of campus visits made in sophomore or junior year. This suggests an interesting "spillover effect" that eventually makes a high school visit in the senior year more productive.

The diminished marginal effect of consecutive annual visits relative to non-repeat visits, coupled with the positive significant effect of some other form of a visit to the high school student, such as at a college fair or a college night, suggests the possibility of alternating high school visits and attendance at college fairs within a multi-year visit plan. Modeling this pattern, however, requires more data than is presently available.

The results of the simulation of the relative performance of the current visit schedule and a school visit program based on maximizing marginal effects suggests substantial changes in the existing visit schedule, including an increased emphasis on schools within commuting distance and Catholic schools.

Using Models to Guide Policy

The model used in the past by our university and at least one other college (Weir, 1991) represented a step forward by using data to guide visit programs. However, the weighting of enrollment data in these models was not itself empirically based. In the case of the model used

in the authors' university, when ranking high schools, only total counts of inquiries, applications, or registrations were used. The method did not account for the sources and dates of inquiries. The marginal effects model developed in this study goes a step further by statistically testing the significance of contextual and policy variables and empirically establishing the weights that should be given to such variables when determining schools to visit. Nevertheless, the model and the way we have used it have limitations worth discussing.

Limitations of the Study

One limitation of this study is that the dependent variable is application activity. One can argue that the ultimate goal of recruitment activities is not simply to generate applications, but also to enroll students. We believe that maximizing the number of applications is one criterion for selecting schools to visit. However, we recognize the need to model the effect of recruitment activities on matriculation and perhaps even retention. Modeling the effect of recruiting activities on enrollment would limit available data, and hence the sample, to only those prospective students who applied and were accepted. In addition, modeling involving student characteristics would require some method of combining criteria, such as the specification of a utility function to be maximized, since there are various desirable qualities that a university seeks in its applicants. These could include academic qualifications, ethnic and racial diversity, and a diverse socio-economic profile that is financially feasible for the university.

Second, only applications from a senior cohort were included in the criterion for productivity used in this investigation. Visits to secondary schools affect also the eventual applications of high school sophomores and juniors. This analysis is confined to seniors, because the university has traditionally focused on seniors and because the time between the collection of recruitment data, the contact with seniors in a school visit, and students'

applications occur within a period of eight months. The equivalent time span for sophomores and juniors would be longer, and therefore, possibly less reliable. Nevertheless, for an analysis to be comprehensive it should include estimates of eventual applications from sophomores and juniors as criteria. However, it would be necessary to weight applications from different cohorts, possibly by discounting applications that are expected to be received later in time.

A third limitation is that the maximization of marginal utility obtained from a recruitment activity must account not only for the marginal benefit, but also for the marginal cost of a marketing activity. In microeconomic theory, the optimal mix of inputs to be utilized or goods to be consumed is that combination where the ratio of the marginal benefit and marginal costs is the same for all inputs or goods. The same optimization logic can be applied to the recruitment activities employed by admissions officers. The model in its current state does not take costs into account.

Future Research

This investigation suggests a variety of research topics. It would be desirable to add to the analysis expected applications from sophomores and juniors contacted during visits, as well as characteristics of likely applicants.

Although the admissions office takes account of additional factors when planning visits, an optimization program to maximize applications subject to constraints related to academic quality, diversity, and net tuition revenue would be helpful.

Finally, combining data on marginal effects with information on marginal costs would demonstrate the relative cost effectiveness of different recruiting efforts. Such an analysis might suggest a reallocation of resources among recruiting activities.

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Table 1

Description of Variables

Variable Name	Description
	Context Variables
	Responses to Recruiting Activities Held during the Sophomore and Junior Year of Current Seniors
DM9900	The number of responses to direct mail sent by the university
CV9900	The number of students who visited the university campus
HSV9900	The number of response cards returned after attending high school visits
OTV9900	The number of response cards to college fairs or nights returned after attending college fairs or college nights
	Characteristics Associated with the High School
METRO	Dummy variable equal to 1 if high school is within commuting distance and 0 otherwise
CATHOLIC	Dummy variable equal to 1 if high school is a Catholic school and 0 otherwise
APP01	Number of applications received from the high school for fall 2001
VISPREV	Dummy variable equal to 1 if high school was visited in the previous year 0 otherwise

Variable Name	Description
	Policy Variables
	Activities during the Senior Year (Main Effects and Interactions)
HSVIND	Dummy variable equal to 1 if high school was visited during the senior year and 0 otherwise
OTVIND	Dummy variable equal to 1 if seniors sent in a response card after attending a college fair or college night and 0 otherwise
HSVXMET	Interaction of HSVIND and METRO
HSVXCV	Interaction of HSVIND and CV9900
HSVXPREV	Interaction of HSVIND and VISPREV
HSVXCATH	Interaction of HSVIND and CATHOLIC

Table 2

Results of Regression of Applications for Admission on Contextual and Policy Variables Affecting a High School Visit Program

Variable	B	SEB	β
DM9900	0.004	0.003	0.010
CV9900	0.597	0.068	0.118*
HSV9900	0.067	0.032	0.027*
OTV9900	0.093	0.015	0.085*
METRO	0.321	0.072	0.023*
CATHOLIC	0.137	0.051	0.011*
APP01	0.667	0.017	0.684*
VISPREV	0.227	0.091	0.014*
HSVIND	0.401	0.103	0.022*
OTVIND	0.694	0.070	0.054*
HSVXMET	0.561	0.194	0.020*

Variable	B	SEB	β
HSVXCV	0.339	0.092	0.051*
HSVXPREV	-0.284	0.148	-0.011*
HSVXCATH	0.414	0.249	0.013*

Note. $R^2 = 0.84$ (N=10,133, $p < .01$).

*$p < .05$

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